Periscope.

a.—ANATOMY AND PHYSIOLOGY OF THE NERVOUS SYSTEM.

FUNCTIONS OF THE BRAIN.—At the session of the Societé de Biologie, Dec. 23 (rep. in *Gaz. des Hopitaux*), M. Francois Franek presented a communication in his own name, and that of M. Pitres, on "the experimental analysis of the movements provoked by excitation of regions of the gray substance of the brain."

These researches still being carried on, have already furnished precise results: 1. *On the comparison of the retardation of the movements produced by the excitation of the regions of the gray substance that constitute the psycho-motor centres of the members, and by the excitation of the subjacent white substance.* 2. *On the constancy of the retardation of the movements, whether the excitations be strong or weak, single or multiple.* 3. *On the quickness of transmissions in the cord of motor incitations from the head.*

M. Franck gave a *resumé* of the experiments which established these three points, and exhibited the graphic traces obtained in each series of researches, and insisted on the special character of those experiments in which the graphic methods of precision employed in M. Marey's laboratory were utilized.

1. *Retardation of the movements according to the precise instant of excitation of the gray and white substance.*

When, in a dog, we irritate that region of the gray matter, excitation of which causes localized movements of the anterior member of the opposite side, taking at the same time on a rapidly rotating registering cylinder, a trace of the movement produced, with electric signals and divisions of time in hundredths of a second, we find the delay of the movements is .065 second (the average figure) after the commencement of the excitation.

This, which may be called the total retardation, is made up of time lost in the muscular action (say .01 second), of the duration of the transmission in the 20 centimetres of nerve between the muscle and the cervical spinal enlargement (perhaps .01 second), and finally the duration of the nervous transmission in the 26 centimetres which represent the distance between the point of excitation in the cortex and the centre of the cervico-dorsal region of the cord. Making all deductions, we have, as the duration of transmission from the external surface of the gray cortex to the origin of the nerves of the anterior member, about 9-200, or it may be, 1-22 of a second, as the nearest figure.

But if we remove in the same animal the thin layer of gray matter irritated in the preceding experiment, so that the irritation is applied directly

to the subjacent white bundles, we find that the time is materially reduced; in place of 9-200 of a second we have only 6-200 of a second; thus the removal of barely two millimetres thickness of gray matter has reduced the delay in the appearance of the movement one-third. We must therefore admit that this gray cortical layer forms a serious obstacle to the nervous transmission, and this is an important character of the really central portions of the nervous system. In the presence of this fact, we cannot admit, with some authors, that the excitation made on the surface of the convolutions only causes movements by exciting the underlying white fibres; *the gray substance acts, not as a conductor but as a centre.*

In noting this fact, MM. Franck and Pitres bring forward a new argument for the theory of the genuine, really central, action of excitable points in the cortical gray substance, a theory already well supported by pathological facts, such as those of monoplegis consecutive to destructive lesions of circumscribed points, the loss of excitability of the subjacent white bundles after the removal of these centres, and by the secondary degenerations of the cord to which Prof. Charcot has called attention in his lectures (*Progrès Médical*, Jan., 1876), three observations of which were communicated to the Societé de Biologie (Oct., 1876).

Still another fact is to be added to those above stated, as establishing the value of this gray substance as a centre: it is the much greater excitability of this gray substance as compared with the white fibres underneath it; this point has been demonstrated by MM. Putnam and Carville and Duret, and verified by MM. Pitres and Francois Franck; the comparative traces exhibited to the society showed the lesser excitability of the white substance. It is therefore needful that the gray matter, as an active agent, should add to the excitation it received itself, to act on the underlying white fibres. This property of reinforcing an excitation, is also characteristic of the really central portions of the nervous system.

2. *The delay of the movement after the beginning of the excitation is constant*, whether the latter be strong or feeble; the same delay is met with whether we employ single or multiple excitations, a single induction discharge or a series of successive discharges. The tracings exhibited by M. Franck prove the reality of the phenomena. It is necessary to add, that the authors have seen in all their experiments the movement of a member when its centre was excited, or the white fibres underlying, even with excitations of the briefest duration, lasting only a thousandth of a second; this is not in agreement with the results announced by Schiff in the appendix to his lectures (Florence, 1873).

3. *Quickness of transmission in the cord of excitations starting from the brain.*—In exciting, *simultaneously* with the same induced currents, the centres for the anterior and posterior members of the same side we cause two movements, which are *successive.*

In a large dog the distance between the centre for the left fore paw and the origin of the nerves of the brachial plexus (middle portion of the cervico-dorsal swelling of the cord), was twenty-six centimetres, the length of the nerve between the cord and the muscles acted upon being twenty centimetres, there was found a delay in the movement caused by the excitation of .065 of a second; deducting from this total retardation the time lost by the

muscle in contracting and that of the transmission in the twenty centimetres of nerve, there remains 9-200 of a second, say 1-22 of a second, which figure expresses the rapidity of transmission of the excitation as far as to the middle of the cervico-dorsal enlargement.

In the same animal the movement of the posterior paw only takes place about 22-200 of a second later than the cortical excitation; deducting from this the duration of the transmission down the thirty centimetres of sciatic (3-200 second) and the time lost by the muscle in contraction, there remain 17-200 of a second as the duration of the transmission of the excitation between the point of gray cortical substance excited and the middle portion of the lumbar enlargement of the cord.

But we have seen that to reach the middle of the cervico-dorsal enlargement, the cortical excitation occupied 9-200 of a second, we must therefore deduct this from the last figure obtained, which gives for the time employed in traversing the 40 centimetres of cord separating the origin of the brachial plexus from the origin of the sciatic 8-200, or 1-25 of a second.

A very simple calculation permits us to deduce from this rapidity in 40 centimetres the quickness in one metre, and we have for one metre 1-10 of a second, consequently motor excitations are transmitted through the cord at *the rate of only ten metres per second.*

Next, in what part of the cord does this transmission of ten metres per second take place? Is it in the white substance or in the gray? This question, which implies the track followed in the cord by the motor impulses, coming from the gray cortical substance of the brain, seems solved by the clinical observations already alluded to; the secondary degenerations of the cord, consecutive to destruction of the cortical motor regions, occupy, as is well known, the posterior portion of the lateral columns.

This is, therefore, in all probability, the route followed by the conductors of voluntary motor excitations, and the indicated figure of ten metres per second applies to the white fibres of the lateral columns and not to the gray substance of the cord. It is needful, nevertheless, to allow something for the partial delay of the transmission in the nuclei of the anterior cornua in relation with the motor roots of the lower member, a retardation which can be studied and ascertained by special experiments on the unilateral reflexes.

At a later meeting, the 29th of December, of the same society, another communication was presented from MM. Pitres and Franck, the substance of which we extract from *Le Progrès Médical*, on the conditions of the production and of the generalization of convulsive phenomena of cortical origin.

I. *In regard to some phenomena following partial destruction of the motor cortical zone* in the dog. If we destroy in the brain of a dog a tract of gray substance, the excitation of which causes limited movements in one of the members on the opposite side of the body, and then after some days if we irritate the white fibres thus deprived of their connections with the gray matter, we find them become completely inexcitable (Albertoni and Michieli). MM. Franck and Pitres have sought to find how much time is required to produce this loss of conductibility.

The next day after the operation they found a notable decrease of excitability; on the second and third day it was necessary to employ energetic currents to cause even slight contractions in the member, and after between 90 and 100 hours the excitability is completely abolished. In the dog, it is also in the course of the fourth day that the peripheral end of a divided nerve ceases to be irritable (Waller, Longet, Ranvier). This analogy between central and peripheral nervous fibres when separated from their trophic centres is not without interest.

While the white matter underlying the centre gradually loses its excitability, the gray matter of the adjoining centres becomes turgescent and inflamed, and, if the inflammation is not intense enough to profoundly alter the structure, we can still see a considerable augmentation of its excitability. Partial epilepsy is now produced with the greatest facility. It is now, often, only needed to make the animal walk, to exercise pressure over the skin covering the cerebral wound, or pass a sponge over the uncovered portion of the brain, to produce the convulsive attacks. It is very curious to observe the gray substance reacting convulsively under the influence of mechanical ageuts, which in the physiological condition cause no motor reaction whatever.

In these conditions the partial epilepsy may be limited to the parts whose cerebral centres have become abnormally excited, and may respect the corresponding member to the destroyed centre. On the 13th of December, MM. Pitres and Franck uncovered the right posterior marginal convolution of a large adult dog, and removed with a curette the zone of gray matter, excitation of which caused movements limited to the left fore limb. The next day the animal exhibited the troubles of motility and of sensibility in this member that we always meet with after ablation of the cortical motor centres. After it was made to walk an instant it was seized with an attack of partial epilepsy, characterized by convulsive jerks, in the left posterior member, and in the left side of the face and neck. The limb, the centre for which had been removed, remained flaccid and immobile during the whole attack. The rapid loss of excitability of the white substance subjacent to the cortical centre destroyed, and the exaggeration of the excitability of the gray substance in the vicinity of a circumscribed lesion, explain a number of pathological facts. The first of these phenomena permits us to understand how very extensive destroying lesions, including the whole gray matter of the cortical motor zone, do not give rise to partial epilepsy, and show also, that, when there is a limited destroying lesion in this zone itself, the partial epilepsy is not the result of any irritation transmitted by the subjacent white fibres, but that it is due to the increased excitability of neighboring centres.

The second accounts for the apparently contradictory fact that generally the lesions that cause partial epilepsy in man, are located near, but outside of the motor zone, and explains why in certain cases of monoplegia of cortical origin, accompanied with partial epilepsy, the convulsions respect the paralyzed member, or at least, begin in other parts of the body.

II. *Concerning certain associated bilateral movements provoked by unilateral excitations of the brain.* When we electrize the cortical motor zone of a dog, whose convolutions are very excitable, it rather frequently happens

that the movements provoked are not limited to the member corresponding to the centre excited. If we place, for example, the rheophores on the centre for the left fore leg, we may obtain muscular contractions, not only in this limb, but also in the opposite one, and sometimes even in the two hind limbs. These associated or generalized movements cannot be attributed to a too great intensity of the exciting current, since they are produced even with a very feeble current, hardly perceptible by the tongue. It is also certain that it is not the result of a shock transmitted mechanically to the remainder of the body by a sudden contraction of a member, for MM. Franck and Pitres have caused them to disappear in one foot by severing its nerves. To explain their production we may have recourse to one of the three following hypotheses :

1. We may assume that nerve fibres leave each centre, transmitting excitations directly to the limbs on both sides of the body. But this hypothesis is opposed by a great number of physiological and pathological facts, and particularly with that of the constant and absolute hemilaterality of the phenomena consecutive to the unilateral destruction of the cortical centres.

2. We may assume that the cortical centres of the two sides of the brain are connected by commissural fibres, and that the excitation of one of these centres may, on the one hand, affect the member on the opposite side of the body, and on the other, the corresponding motor centre of the opposite hemisphere. But this hypothesis is invalidated by the following experiment : MM. Franck and Pitres removed the cortical centre for the left fore limb in the right hemisphere of a dog. Four days later they exposed in the left hemisphere the centre for the right leg, and, exciting it, they obtained bilateral movements.

3. The third hypothesis is the most probable one. It is probable that there exist outside of the cerebrum, in the pons or the medulla, centres for motor association through which a unilateral excitation of a limited tract may be transmitted to the other side of the body, or even be generalized. It seems very probable that a similar mechanism acts in generalizing the attacks of partial epilepsy. M. Albertoni has shown that after the destruction of the cortical motor zone of one side, and the loss of excitability of the subjacent white substance, we may cause generalized epileptiform attacks in the dog by excitation of the hemisphere of the opposite side.

MM. Franck and Pitres have repeated this experiment, and have obtained the same results. In a dog six days after the complete ablation of the cortical centre for the left fore limb, they exposed the motor zone of the opposite side, and provoked an attack of partial epilepsy which became generalized, and in the course of which they noticed that the member whose cortical motor centre had been destroyed six days before was always very noticeably convulsed.

These facts seem to show that convulsions of cortical origin are not produced directly by lesions of the brain, but that these lesions act on extra-cerebral centres, centres in which excitations of a very limited part may extend and generalize their effects. These explanations, moreover, leave to partial epilepsy all its clinical importance, and all its diagnostic value ; they only enable us to understand the complexity of the elements that come into play in its production and those that permit its generalization.

At the session of the Soc. de Biologie, Dec. 30th (rep. in *Le Progrès Médical*), MM. Franck and Pitres offered another communication on the effects of limited excitation of the bundles of the centrum ovale and the internal capsule. The study of the pathology of the centrum ovale of the hemispheres has led to the opinion that the white fibres which leave the excitable regions of the gray substance of the cortex, and connect them with the central ganglia, are grouped into distinct bundles, preserving throughout their course through the white substance of the brain, their functional independence. Numerous pathological observations show, in fact, in the most positive manner, that limited lesions of the centrum ovale may give rise to monoplegias, which certainly would not occur were not the fibres underlying the cortical motor centres grouped in separate fascicles

MM. Franck and Pitres have undertaken to test, experimentally, this hypothesis, and the result of their investigations has been to verify it. They exposed in a dog the motor zone, and after fixing accurately the location of the principal psychomotor centres, they made horizontal sections of the hemisphere, exciting the different uncovered portions of the white substance after each mutilation. In so doing, they always found that it was possible to obtain, by exciting sufficiently limited points of this white substance, isolated movements altogether similar to those obtained in the beginning of the experiment by irritation of the different regions of the gray substance.

At the base of the radiant crown of Reil, and in the internal capsule itself, the bundles of white fibres still preserve their functional independence. They are in juxtaposition without mingling, and the separate excitation of different bundles causes movements limited to certain muscular groups on the opposite side of the body. It is hardly necessary to state that to obtain these the excitations must be localized in very limited spaces; if the electrodes are more than from two to four millimetres apart, very extensive and confused movements are produced.

In the dog the anterior half of the surface of the internal capsule is alone excitable, and its bundles are grouped in the following manner:

1. Well in front we find the fibres, excitation of which causes movements of the face and eyelids of the opposite side; then we have from before backwards.
2. The bundle of fibres for the fore limb.
3. A rather extensive bundle, excitation of which, causes movements of both limbs of the opposite side.
4. A very minute bundle to the posterior member alone; and, finally,
5. At the horizon of the posterior portion of the nucleus caudatus we find a very well marked bundle of fibres, excitation of which causes the isolated movement of raising the ear of the opposite side.

These experiments confirm, as regards the physiology of the centrum ovale, the ideas suggested by careful study of pathological observations. As regards the internal capsule, they seem at first to be opposed by the fact that hemiplegias caused by lesions of this tract are always total. But in reality this disaccordance is only apparent. The internal capsule, in fact, is a narrow junction of various routes of conduction, and in order to obtain limited movements by its excitation, it is needful that the electrodes should be very closely approached to each other. But the pathological alterations

of the capsule, in the great majority of cases, are gross lesions, such as hemorrhages or patches of softening, and in such conditions the hemiplegia is complete, since the lesion is too extensive to involve only a single one of the many functionally distinct hundles of which the capsule is made up. It is highly probahle that a very limited lesion of the capsule might give rise to a limited paralysis on the opposite side of the hody. But cases of this kind are so extremely rare that no well authenticated case exists in our literature.

The existence of numerous functionally distinct fasciculi in the internal capsule, therefore, docs not conflict in any way with the law laid down by Charcot, according to which central lesions extending into the internal capsule always produce a complete hemiplegia of the opposite side of the hody. The physiological results of MM. Pitres and Franck, enahle us to understand certain facts hitherto unsatisfactorily explained. Every one who has observed many cases of hemiplegia knows that it is not very unusual to see, in cases of total hemiplegia, a very marked predominance of the paralysis in the face, or in the memhers. One patient, who hy the inertia, or rigidity of the memhers, is unahle to leave his couch, can yet execute certain movements with his arm; another, whose arm is ahsolutely inert, or fixed hy a secondary contracture into a permanent state of flexion, can nevertheless walk with comparative facility. Cases of this kind most frequently coincide with central lesions affecting the internal capsule, and are explained prohahly by the fact that not all the fihres that enter into its formation are affected in the same degree. An analysis of some ohservations collected during the past year in the service of M. Charcot, seem even to indicate the paralysis predominates in the superior member when the lesion is most marked in the anterior portions of the internal capsule, and in the leg when it affects especially the posterior part of its motor tract.

At the meeting of Jan. 26 (rep. in *Gaz. des Hopitaux*, No. 12), M. Franck presented in the names of M. Pitres and himself the results of their experiments as to the inexcitability of the lenticular nucleus and the exaggerated excitahility of the internal capsule.

1. When we localize the excitation to the gray matter of the striate hody, exposed hy the ablation of a cube of brain substance, we provoke no movement. At the moment when the electrodes come in contact with the surface of the section of the internal capsule, the movement takes place with the characters of hrusqueness and generalization already indicated. This fact has been frequently verified by MM. Pitres and Franck, and was evident from the tracings submitted to the society. It follows from it, that, when we apply the excitation to the corpus striatum, it is not the striate hody itself that is excited, hut the white fibres it contains. In fact, in pushing more and more deeply into the hrain, electrodes isolated to their points, and in following the floor of the lateral ventricle, we find that the excitation remains for an instant without effect, and that the movement then occurs all at once and throughout the whole hody: this motor explosion coincides with the instant that the electrodes touch the internal capsule.

2. When we compare the intensity of the motor phenomena, produced

by even slight excitation of the capsule, with the relatively feeble reaction caused by stronger excitations applied to the white bundles of the centrum ovale, we are struck with the hyperexcitability of the fibres at the horizon of the capsule. MM. Pitres and Franck offer the following hypothesis for the interpretation of the phenomena, which they will endeavor to test, and which already is supported by one rather conclusive experiment; the anterior portion of the internal capsule contains not only fibres from the cortical motor zone, but also those furnished by the corpus striatum constituting an adjunct system, whence the more violent reaction from equal excitations when we excite the capsule than when we excite the white fibres of the centrum ovale. In a dog, whose cortical centre for the left anterior limb had been removed for six months, and the corresponding fibres had lost their excitability, MM. Franck and Pitres produced movements in the left fore leg by exciting the capsule, that is to say, without doubt, the excitation of healthy fibres from the striate body. Further experiments are in progress and will be published.

H. Nothnagel (*Virchow's Archiv*, 71 Bd., Heft III.) treats in the present article of the results of division of the internal capsule in the rabbit. The anterior part of it, between the nucleus lenticularis and nucleus caudatus, was transversely divided with a protected knife.

Class A. Both nuclei lenticulares were previously destroyed by injection of chromic acid. When the characteristic symptoms, absence of all spontaneous movements, were developed, division of the two capsules was performed. The result was total paralysis of the anterior extremities. (According to the experiments there seems to have been also anæsthesia of these parts, but Nothnagel does not refer to that in his remarks.)

Class B. Simple division of both internal capsules. With the closest scrutiny Nothnagel could not detect any difference whatever between the operated animals and uninjured rabbits.

Division of one capsule alone gave rise to similar symptoms as the destruction of the corpus striatum, though of less intensity, viz.: distortion of the spinal column with the concavity turned towards the side of the lesion, and deviation of the extremities also towards the injured side.

Nothnagel therefore concludes that motor tracts pass both through the corpus striatum and the internal capsule, and that destruction of either of these parts alone does not suffice to produce any marked paralysis in rabbits.

Hermann Munk, *Berliner klin. Wochenschr.*, No. 35, 1877 (abstr. in *Revue des Sci. Méd.*)

On the 23d of March, 1877, the author communicated to the Physiological Society of Berlin the results of his first investigations. He extirpated, in medium sized dogs, disks of cortical substance, 15 millimetres in diameter, and 2 millimetres in thickness, from the surface of the parietal, occipital, and temporal lobes. In some cases he removed symmetrical portions of the two hemispheres successively, in others simultaneously.

The first fact deduced from these experiments was that the cortical surface examined included an anterior tract purely motor, and a posterior one

purely sensory. The line separating these might be drawn vertically from the sylvian fissure to the falx cerebri; ablation of parts in front of this line (parietal lobe) always caused motor disturbances, while those performed posterior to it produced nothing of the sort. On the other hand, extirpations of parts posterior to this line caused psychic blindness (*Seelenblindheit*) if located in the occipital lobe, near its postero-superior extremity, and a psychic deafness (*Seelentaubheit*) when in the temporal lobe near its inferior extremity. In the first case the animal lost the commemorative images (*Erinnerungsbilder*) of visual impressions; in the second, those of auditive impressions. Extirpation of parts in front or below the postero-superior extremity of the occipital lobe as well as those between this point and the inferior extremity of the temporal lobe, were without effect.

Munk also observed that the motor disorders and the psychic blindness disappeared progressively in the space of from four to six weeks, and ended in leaving no appreciable symptoms; the animals operated upon appearing in no way different from others. He was able also to follow very neatly the manner in which the blind animals regained their vision. This last circumstance led to the conjecture that the visual and auditory spheres extend rather beyond the occipital and temporal lobes, and that within them the commemorative images are arranged, according to the order of perceptions, around a central point, from which they extend toward the periphery, and after the extirpation of the above mentioned points which contain the whole or a majority of the images existing at the actual moment, the remainder of the tract in the vicinity supplies itself with new ones.

In continuing his investigations the author took a number of pups of the same litter, and on the fourth or sixth day after birth he destroyed in one-third of them the eye, and in another third the ear, in some of one, and in others, of both sides. The remaining third were not mutilated. A very small proportion of the pups operated upon, were hindered in their development, but the majority grew as fast or better than the uninjured ones. At the end of eight to eleven weeks he sacrificed all of the dogs which had developed normally, whether mutilated or not. In the blind dogs, the occipital lobe, already recognized as the sphere of vision, had suffered an arrest of development, the same was the case with the temporal lobe in the deaf dogs. On the other hand, the temporal lobe in the blind dogs and the occipital lobe in the deaf ones were exaggerated in volume so that the volume of the hemispheres was not notably diminished. In comparing the blind animals with the deaf ones it was noticed that the temporal lobe in the former was developed toward the falx, and the occipital lobe in the latter was most prominent toward the temporal region.

The various commemorative images have a fixed seat, localized in the cortex. Thus after extirpation of the visual centre at the upper posterior angle of the occipital lobe, Munk twice noticed, with the loss of all other commemorative images, the preservation of a single one in its integrity. In one dog it was the image of the bucket from which he was accustomed to drink, in the other it was that of the motion which made him offer his paw.

Finally in his last experiments the author has been able to note the gradual return of the auditive perceptions.

THE INNERVATION OF THE UTERUS.—Von Basch and Hoffmann, *Med. Jahrbuech.*, 1877, heft IV. (abstr. in *Gaz. Med. di Roma*) have studied the innervation of the uterus in the dog with some interesting results. They refer the uterine nerves to two sources: one set from the union of branches from the posterior mesenteric ganglion and the inferior hypogastric plexus, and the other, the *nervi erigentes* of Eckhardt, from the sacral plexus. In forty-nine careful experiments on curarized dogs the following were the principal phenomena observed:

Stimulation of the hypogastric nerves constantly caused movement of the cervix downwards, and at the same time, but not always, the mouth of the uterus opened; both of these being in the opinion of the authors, only passive results of the contraction of the circular fibres of the uterine neck, which was the immediate effect of the excitation of these nerves.

The *nervi erigentes* have undoubtedly a motor function. In many cases their stimulation produced shortening of the body and stretching of the neck and contraction of the vagina. It was remarked that during the stimulatiou a quantity of vaginal mucus exuded from the split vagina into the abdomen. The orifice of the uterus is always closed during the stimulation of these nerves; if open at the commencement, it closes. The authors consider the stretching of the cervix and closure of the mouth as passive results of the contraction of the longitudinal muscular fibres under the excitation of the *nervi erigentes*. These are therefore antagonists of the hypogastric nerves which act on the circular fibres. The irritation of the lumbar cord has the same effect as that of the *nervi erigentes*.

Suspension of the respiration produces a movement of the cervix and opening of the mouth, phenomena referred to irritation of the hypogastric nerves. This effect is inconstant, but blood charged with carbonic acid excites the hypogastric nerves more strongly and frequently than the *nervi erigentes*. Excitation of the sciatic causes, almost always complicated motor phenomena, but in most cases those dependent on the excitation of the hypogastric nerves predominate.

Although the movement of the cervix and the changes of form of the uterine orifice are thus shown to be dependent on these two sets of nerves, they may also occur independent of either of them. If the body of the uterus in repose is scratched with the finger or sound the cervix will advance and the mouth dilate. This is brought about in a reflex way from ganglia in the upper portion of the vagina.

The vessels of the uterus are innervated by the same nerves which supply its muscular fibres. The hypogastric nerves supply the vaso-constrictors and the *nervi erigentes* the dilators. Stimulation of the hypogastrics causes a disappearance of the arterial and capillary injection of the uterus, the veins remaining full, and during the irritation the flow from a cut on the cervix becomes less and stops. The opposite effect follows excitation of the *nervi erigentes*, the organ becomes strongly injected, wounds bleed more freely and the temperature of the body is slightly increased.

The vaso-constrictor fibres in the hypogastric nerves are derived from the splanchnic nerves; excitation of these nerves has the same effect so long as the hypogastrics are intact, but is ineffectual when they are divided.

Contraction of the uterine vessels may also be produced in a reflex way by

irritation of the sciatic. In this case it also seems to depend on the hypogastrics, for if these are cut we have, not a constriction, but an active dilatation due to reflex influence of the *nervi erigentes.* When these last are divided, irritation of the sciatic is without effect on the vascular condition of the uterus.

THE INHIBITORY NERVOUS SYSTEM IN NEWBORN INFANTS. Otto Soltmann, *Jahrb. f. Kinderheilk.*, XI. 101, 115 (abstr. in *Revue des Sci. Méd.*).

In a previous memoir entitled "The Functions of the Brain in the Newborn," the author attempted to prove that all the movements of newborn infants were involuntary, instinctive and automatic. He showed besides that even in the reflexes, the brain was inactive, and the reflex movements were entirely spinal in their origin. Thus the closing of the eyes caused by touching their surface, is not seen in newborn animals until after they have once learned the danger of the contact.

The brain in so far as it is the organ of thought, will and intelligence, appears to be absolutely inactive in the newborn, and the author was able to determine experimentally in very young animals, the absence of psychomotor centres in the cerebral cortex. Whence it is evident that they possess, as is generally admitted, an excessive predisposition to reflex movements, a *spasmophilism*, because the brain is, after a fashion, deprived of will, and cannot exercise any control over the reflexes.

But we know, moreover, that outside of the mechanism of arrest of the organ of thought, there are in the brain other centres of arrest analogous to those in the thalamus of the frog described by Setschenow.

In 1869 Simonoff discovered a similar mechanism in the anterior lobes of the hemispheres in mammals.

In irritating the parts in question with the galvanic current he was able to prevent reflex movements. But Soltmann, repeating Simonoff's experiments on newborn animals, discovered that these centres of arrest were lacking in them. The brain of the newborn animal is incapable of transmitting to the cord the excitations designed to moderate the reflexes which have their seat in the latter organ. This fact is evidently very significant as regards the pathogeny of convulsions.

It remains now to see how the cord comports itself as regards the centres of arrest in the newborn. Already Goltz and Nothnagel, and later Levisson, by dividing the cord just below the medulla were able to demonstrate that the reflex movements of adduction or extension backwards of the feet, which we observe in animals when we lightly touch the arms or claws, do not appear when we pinch the limbs just before the groin or the trunk or when we bandage them. But Soltmann shows that under the same circumstances in newborn animals these movements instead of being abolished are, on the contrary, exaggerated. The apparatus of arrest in the cord does not exist in the newborn.

On the other hand, Soltmann, exciting galvanically the vagus nerve or the inhibitory nerve of the heart in animals of a certain age and in those newly born, observed that in these last the nerve was much more sleuder, it was needful also to employ much more intense currents than in the former,

to produce a slowing of the heart, without moreover succeeding in arresting its contractions.

The energy of the vagus is therefore insufficient in the newborn, and this is undoubtedly the reason why there is in them such an excessive frequency of the cardiac pulse as compared with adults, and why it undergoes such extensive alterations. We may explain also by this the frequency and the irregularity of the pulse in the newly born, and that other fact of daily observation, viz. : that we see under every slight influence a notable acceleration of the movements of the heart. The considerations are applicable to the irregularity and variable frequency of the respiratory movements in the newborn.

It is well known that in the basilar meningitis of infants of a certain age, there is in the first period a very characteristic slowing of the pulse due to irritation of the vagus by the exudation, and in the third stage of the disease an enormous acceleration due to the compression of the fibres of the vagus by the exudation and the consequent paralysis of the nerve. But in the newly-born infant these symptoms are different from the usual type ; from the commencement of the trouble the pulse does not cease to be irregular and intermittent, a peculiarity which explains sufficiently the condition of the nervous system of arrest in very young infants, and which has given rise to errors of diagnosis.

Collateral Innervation.—This term is applied by S. Stricker (*Wiener Med. Jahrb.*, 1877, § 415) to the gradual restoration of vascular tonus after the destruction of the greater part of the vaso-motor nerves of that district.

On dividing the cord of a dog in the lower dorsal region, there follows a hyperæmia of long duration of both hind legs. This is due to the section of vaso-constrictor nerves, whose centre is higher up in the cord. If it were dependent on the traumatic irritation of vaso-dilator nerves, hyperæmia would only remain a few minutes. This hyperæmia passes off in the course of a few days. The restoration of vascular tonus is an instance of collateral innervation ; it is due to the activity of nerves, whose centre is higher up in the cord, and which leave the cord above the point of section. The proof of this is furnished by the fact that a second section of the cord at the level of the sixth rib, gives rise to a new and permanent hyperæmia of the hind legs. The same result may be obtained by division of the sciatic nerve, in which case also the still intact vaso-motor fibres are severed from their vessels. The reason why these accessory nerves do not enter into activity immediately after section of the principal vaso-motor strands, Stricker has not yet been able to explain. (*Centralblatt*, 1878, No. 8.)

Nerve Tubes of the Plagiostomi.—Gustaf Retzius, *Nordiskt Med. Arkiv.* IX., IV., No. 23, 1877, has investigated the structure of the nerve tubes in the rays. Contrary to the description of M. Ranvier, according to which, of the nuclei, three or more of which are found in each segment of the sheath of Schwann, only one properly belongs to it, the others to a special external envelope, Retzius found all the nuclei situated on the internal face of the sheath of Schwann, with the sole exception of those that pertain

to the homologue of the fibrillary sheath and are scattered here and there among the tubes. He proves, moreover, that an evident aualogy exists between the situation and the reciprocal distances of these nuclei, and the dispositions that Axel Key and the author have already described in the nerve tubes of the pike. The nerve tubes of cartilaginous and osseous fishes are therefore constructed according to the same fundamental plan in all these relations.

THE PHYSIOLOGY OF THE MEDULLA.—MM. Laborde, Matthias Duval and Graux have undertaken a series of researches for the purpose of clearing up certain obscure points in regard to the physiology and structure of the medulla, and particularly: 1. On the associated movements of the eyes. 2. On the trophic phenomena and sensibility of the eye, of the nose, the ear and the face in general.

M. Laborde, in giving the results of his researches to the Society of Biology, insisted first on the difficultics of experimentation in the region of the nervous axis; so much the greater since, when we have to do with such delicate observations as those of the ocular movements, modifications of the sensibility of the eye and nostrils, etc., previous mutilations needful to expose the bulb will not answer, the functional integrity of the subject is needful. To explore the medulla experimentally, not being able to fully expose it, we are forced to get at it indirectly through the occipito-atloid space. It is moreover impossible, in this case, to explore the floor of the fourth ventricle without touching the cerebellum. A mere glance at the anatomical topography of the part is enough to demonstrate this. But it is easy to clearly separate the functional disorders attributable to lesions of the cerebellum from those due to lesions of the medulla.

M. Laborde selected for his experiments a triangular point when he wished to make a simple puncture, or a narrow blade when he wished to make a section, but whatever it was, the instrument had to be mounted on a long and narrow handle.

The results of these investigations relate to the majority of the functions of the medulla, either as it is an autonomous centre, or a centre of origin of the nerves.

As an autonomous functional centre, M. Laborde only speaks of it in its capacity as influencing the respiratory mechanism; in many experiments, even at the moment of the production of the lesion, there was observed such an instantaneous arrest of the respiratory movements, as to lead to the belief that the so-called vital point had been touched. But the hand over the precordial region perceived very distinctly the cardiac pulsations which continue with their usual force, rhythm, and frequency, and then, after a few seconds, one or two minutes or more, the respiratory movements gradually take on their amplitude. This respiratory syncope has been in some cases long enough to cause the complete asphyxic transformation of arterial into nervous blood. The experimental lesion in these cases is always in the inferior portion of the floor of the fourth ventricle, very near, or on the point of the calamus around the raphe. Successive sections made at the horizon of the lesion, show that it principally involves the points of origin

of the pneumogastric. M. Laborde and his colleagues will take up this line of research at a later date.

M. Laborde comes next to the influence of the medulla upon the associated movements of the eyes. An attentive observation of these various ocular deviations, enables us to classify them into two distinct groups.

1. The first group includes the disassociated or asynergic deviations in which there is a complete rupture of equilibrium of the associated ocular movements; it is a veritable ataxia or inco-ordination of these movements. This group comprehends all the cases of double convergent or divergent strabismus, especially the last, and all in which one of the eyes is directed upward, the other downward, one directed outward and upward, the other inward and downward, etc.; and *vice versa*. These have been always the result of a lesion of the cerebellum. Nevertheless, an analogous result may be observed when it affects the lateral columns of the medulla (restiform bodies), which is to be explained by the fact that it is the prolongation of the cerebellar fibres that in this case are affected. The disassociated deviations, those which constitute a veritable ocular ataxia, are essentially in the functional domain of the cerebellum.

2. The second group comprises the associated, synergic, conjugated deviations. The conjugated strabismuses are nothing else than a more permanent form of the usual associated movements of binocular vision.

After some anatomical and physiological considerations on the different pairs of ocular muscles, and on the mechanism of associated movements in the physiological condition, M. Laborde deems that he can sum up the results obtained in the following propositions: Every time, says he, that the experimental lesion affects a part sufficiently near, in its inferior limit, to the nucleus of the sixth pair, to touch that nucleus, and especially whenever it directly occupies that nucleus, there is immediately, even at the moment of the production of the lesion, conjugate deviation or strabismus, constantly, in these cases, accompanied by nystagmus, and the more or less pronounced turning of the head toward the injured side.

This is the chief result, but this proposition implies two distinct orders of facts; a first, in which the conjugate deviation is produced by functional irritation, and a second in which it is due to paralysis: In the first the deviation is produced toward the side of the lesion, which has not destroyed the nucleus, or separated it from its radicular fibres, and which acts only by irritation. In the second case the deviation is toward the opposite side from the lesion, which has completely destroyed the nucleus, or cut off communication with its radicular fibres, producing motor paralysis.

The difference in the deviation in these two cases is easily explained: In the first, the rectus externus, under the influence of the excitation of the nucleus of the sixth pair, which innervates it, contracts more or less violently and carries outwards the corresponding orbit (divergent strabismus), while the rectus internus of the opposite side, by its morbid contraction under the influence of the same functional irritation draws the eye inwards (convergent strabismus). The result is a conjugate strabismus to the right if the lesion is on that side, and to the left if on that side. In the second case, on the other hand, the same muscles become paralyzed by the complete section of the fibres by which they are innervated, the antagonistic

muscles act, and the conjugate deviation toward the side opposite the lesion. According to this a double lesion affecting at once the right and the left sides ought to have a negative result as regards the ocular deviations, and this is in fact what occurs.

The influence of the internal recti over the conjugate deviation of the eyes is not usually so great as that of the external recti, which seems to show that it is more easy to affect by an experimental lesion the radicular fibres proper of the external motor oculi than the original anastomotic fibres of the motor oculi communis; or rather, that there is a marked predominance of the first over the second.

However it may be, the conclusion which is clearly drawn from these experimental facts, is that the nucleus of origin of the sixth nerve sends anastomotic fibres to the common motor oculi of the opposite side, and that it is to this arrangement that the functional association of the eyes in binocular vision is due. The results of experimental physiology confirm those of anatomy. Clinical observation also supports this demonstration, as was proven by a case reported later by M. Graux. *Gaz. des Hopitaux*, Dec. 9.

In a later communication (*Gaz. des Hopitaux*, No. 2, 1878), M. Laborde gives the results of the investigations of M. Duval and himself, in regard to the trophic and sensory disorders following the experimental lesion of the descending root of the trigeminus. If the lesion is made in the nucleus of the sixth, it is very difficult to avoid injuring that of the facial nerve also, and producing facial paralysis. Now if the injury is made just a little toward the thickness of the lateral pyramid of the restiform body, another set of symptoms appear, conjunctival congestion and inflammation coming on with great rapidity, the eye being completely destroyed in the rabbit in twenty-four hours. The same trophic trouble is observed in the pituitary membrane and the lining membrane of the middle ear. These phenomena indicate that at the injured point exist radicular fibres which preside over nutrition in these parts, and these fibres are exactly those of the descending branch of the fifth nerve, demonstrated by M. Duval. To determine the exact inferior limit of these fibres MM. Laborde and Duval made repeated sections of the medulla from above downward, and found that they did not extend below the point of the calamus, if, indeed, they extend so far.

The following is the summary of the results of all these investigations:

1. That the medullary nucleus of the sixth nerve contains, and sends anastomotic fibres to the nucleus of the corresponding nerve of the opposite side.

These fibres by unifying and rendering synergic the functional exercise, that is, the simultaneous contraction of the external rectus of one side and the internal rectus of the other, insure the associated movements of the eyes in binocular vision.

These associated movements appear to have their functional centre of origin in the medulla, in that part where the said nucleus exists, while it is in the cerebellum or the medullary prolongations of the cerebellar fibres that the principal co-ordinating power for the ocular movements appears to reside.

2. The constant production of complete anæsthesia and trophic dis-

orders of the eye after experimental lesion, affecting seriously the upper half of the lateral pyramids, demonstrates the existence of medullary fibres belonging to the descending root of the trigeminus.

Reflex Inhibition of Salivary Secretion.—John Pawlow, *Pflüger's Archiv.* LX., IV. and V., Jan., 1878.

In agreement with previous experimenters Pawlow found the salivary secretion of the curarized dog increased by strong irritation of the sciatic nerve. But on *diminishing* the strength of the exciting current, a point is reached at which irritation of the sciatic nerve inhibits the action of the gland. A similar inhibition is observed by exposure of the peritoneal cavity and by raising a portion of the gut out of the cavity. This effect is due to inhibition at the central origin of the chorda tympani, since excitation of the lingual nerve, which otherwise results in copious reflex salivation, is of much less influence on the gland during the continuance of the inhibitory irritation. The author also states that curare, known to increase salivation, will finally check it in very large doses.

Effects of Section of the Spinal Cord upon Animal Temperature. —We copy the following from the New York *Medical Record* of Jan. 19:

Some time since the sum of five hundred dollars was granted to Professor H. C. Wood, Jr., of Philadelphia, by the Smithsonian Institution, to enable him to prosecute with thoroughness and success a series of experiments relative to the effects of artificial lesions of the various parts of the nervous system upon the evolution and production of animal heat; the results of the experiments to be published in the contributions of the Smithsonian Institution.

Through the kindness of Dr. Wood we are enabled to lay before the medical profession his results, so far as concerns *the section of the cord* upon animal heat.

As is well known, experiments of much the same nature as those which we are about to describe were instituted in 1837 by Sir Benjamin Brodie, and later by Bernard, Schiff, Naunyn and Quincke, Rosenthal, and Binz. According to these authorities it would seem that if the spinal cord of a rabbit be cut in the lower cervical region (the air of the room being lower than the temperature of the animal's body), the animal's temperature at once falls so that at the moment of death its heat is below normal. If, however, the external temperature be high, and the animal be wrapped in raw cotton, the fall of temperature is succeeded by a rise, so that the animal dies in a state of intense fever. To settle this point a crucial experiment was undertaken by Naunyn and Quincke, which seemed to prove beyond a doubt that the rise of temperature was to some extent certainly dependent upon the operation.

In conducting his researches, Dr. Wood has confined himself exclusively to experiments upon the dog, other commonly employed animals being too small for the performance of delicate experiments upon the brain and nerves.

A wooden box was constructed, open at the top, and about three feet square; also two metallic boxes, the larger of them also open at the top, and three inches smaller each way than the wooden box; the other about three inches smaller each way than the first and having its top-piece perforated with three holes,—a large hole in the centre, and, on each side of this, smaller apertures into which gutta-percha tubes could be screwed. The larger metallic box was then placed inside of the wooden chest, and the interstices surrounding it carefully and tightly packed with sawdust. Water enough was poured into it—*i. e.*, the larger metal box—completely to surround the smaller metal box when placed inside of it. After cutting its cord, the dog was then placed within the innermost box, the gutta percha tubes were screwed into place, and a closely fitting lid to the whole apparatus so adjusted as to cut off both the dog and the water surrounding the vessel which held it from the outer air of the room. A suction pump was attached to the end of one of the gutta percha tubes (the end of the other tube being left patulous) so that air might be drawn through the metal box which held the animal. A cut-off from the tube of exit was so arranged that specimens of air could be received into it, and analyzed for heat by a thermometer, and for moisture by a calcium tube. The difference in the number of heat units existing in the air, after its passage through the box, and in the water surrounding the box which held the dog whose cord was cut, was then estimated by means of the following formula: Q=w×t×sp. h.; Q=heat units; w=weight of air or water; t=rise of temperature of air or water; and sp. h.=specific heat.

The bulk of the air was reduced to the bulk of air at 32°. This was weighed and the specific heat obtained. After a number of painstaking and laborious experiments, Professor Wood has been able to reach the following conclusions, viz.: *At a low external temperature, after section of the cord, there is increased evolution with diminished production of heat; at a high external temperature, both the production and evolution of heat are diminished. After section of the cord the animal dies in winter of cold, and in summer lives much longer on account of the high external heat.* It will be at once noted that this fact has a very important application to narcotic poisoning, to collapse, as seen, after exhaustion by heat, etc., and to thermic fever; the hot bath being the best treatment for collapse and narcotic poison, and the cold bath for thermic fever. (Collapse from heat and thermic fever are usually confounded. In collapse the internal temperature is below normal, while in thermic fever it is above.)

Professor Wood has also discovered the fact that the instant fall of temperature, after section of the cord, is due to *vaso-motor paralysis, producing paralysis of the arterioles at the surface, thus obliterating the superficial cold layer of the body, and removing the only barrier to the animal's internal heat.* The Doctor has thus shown that *temperature is no guide to the amount of heat given off in such cases, and that fever simply reduces itself to a question of the difference in the relation of the heat-producing and heat-elevating powers; that the heat-elevating power is no longer compensatory to the heat-producing when the cord is cut.*

The experiments of Owsjannikow, which located the governing vaso-motor centre of the brain in a space whose upper boundary is one or two millimetres below the corpora quadrigemina, and whose lower boundary is from

four to five millimetres above the point of the calamus scriptorius (*Berichte*, etc., Bd. XXIII.) have received full confirmation at Dr. Wood's hands.

Vaso-motor Centres in the Cortex.—Dr. B. Kuessner, *Centralbl. f. d. Med. Wissensch.*, No. 45, 1877, announces that he has performed a great number of experiments to test the question of the existence of vaso-motor centres in the cortex of the hemispheres, as described by Eulenberg and Landois (*Virchow's Archiv*, LXVIII., and Eulenberg, *Berliner klin. Wochensch.*, Nos. 42, 43, 1876), and which were confirmed by Hitzig in a short note in the *Centralblatt*, 1876, No. 18, but had obtained throughout only negative results. A full account of his experiments will be published in the *Archiv fuer Psychiatrie u. Nervenkrankheiten.*

Nerve Terminations in the Tactile Corpuscles.—At the session of the French Academy of Sciences, Nov. 26, 1877 (rep. in *L'Union Médicale*), M. Cl. Bernard presented, for M. Ranvier, a communication on the distribution or rather the termination of the nerves in the tactile corpuscles. Up to the present, it has been believed that the sensory nerves entered into the cutaneous terminal cells, in the form of a swelling or tumefication, and that the sense of tact is exercised directly on these cells. M. Rauvier thinks that this is not the case. By coloring the final nerve ramifications black with gold salts he had seen terminal filaments ending between two cells without entering them; there was no continuity between the cells and the nerves. The cells play the part of organs of protection or reinforcement. This remains to be studied. At present, the question is a purely anatomical one, and may be formulated as follows: The nerves terminate by free extremities between two cells, and, consequently, we always find more cells than nerve terminations. It was in the bill of the duck, a very sensitive organ, that M. Ranvier had brought to light this arrangement.

Clarke's Columns.—Previous researches have rendered it probable, that the so-called lateral cerebellar fibres which connect Clarke's columns with Flechsig's lateral cerebellar tracts, take their origin in the cells of the columns of Clarke. But this supposition has not yet been fully proven. This has been now accomplished by Dr. A. Pick (*Centralblatt*, 1878, No. 2). In the normal cord of a child of one and one-half years, hardened in bichromate of ammonia and colored with carmine, he found the cells of the columns of Clarke (in the lumbar portion) giving rise each to one process directed forward and inward. This process soon changed its course and joined the horizontal cerebellar fibres.

Pick points to the importance of the simultaneous occurrence of degeneration in the lateral cerebellar tracts and of partial atrophy of the columns of Clarke, observed in some cases on record.

Nerves of Sweat-Glands.—F. Nawrocki (*Centralblatt f. d. Med. Wiss.*, 1878, No. 1 and 2), repeated and extended the experiments of Luchsinger. Like Luchsinger he operated on young cats and traced the course of the

nerves both by direct irritation and by section with subsequent excitation of the centre by warmth. As the result he found in the medulla oblongata a centre for the sweat-nerves of both fore and hind legs. From this the fibres for the anterior extremity follow the cord, leave it at the fourth dorsal vertebra, enter the ganglion stellatum and thence pass into the brachial plexus. Following the ulnar and median nerves they are found inequally distributed in these two nerves in different animals. The fibres going to the hind legs pass in the cord up to its lumbar portion, thence enter the abdominal sympathetic and finally join the sciatic nerve.

In the following number of the *Centralblatt* (No. 3), Luchsinger mentions that he has also traced the fibres of the fore leg along the same paths.

The following are the titles of some recent memoirs on the Anatomy and Physiology of the Nervous System :

Ott, Nerve Stretching; Its Physiological Action, *Ohio Med. and Surg. Journal*, Feb.; The Effect of Electrotonus on the Rapidity of the Transmission of Nerve Force, *Phil. Med. Times*, Feb. 2; Dietl and Vintschgau, The State of the Physiological Reaction-period under the Influence of Morphine, Coffee, and Wine, *Pflueger's Archiv*, XVI., VIII., Feb.; Kowalewski and Nawrocki, Sensory Nerves of the Muscles, *Centralbl. f. d. Med. Wissensch.*, No. 9; Luchsinger, On the Sweat Secretion, *Ibid.*

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b.—PATHOLOGY OF THE NERVOUS SYSTEM AND MIND, AND PATHOLOGICAL ANATOMY.

Sensibility in Tabes dorsalis.—E. Remak (*Arch. f. Psych.*, etc., VII., H. 3) observed the following new phenomenon in the case of a man afflicted for years with ataxia. On searching for the minimum current, just sufficient to produce the feeling of formication on applying the faradic brush to the skin of the thigh, he found, that the sensibility at first quite acute, soon became exhausted. This fatigue necessitated such an increase in the strength of current for perception, that finally the current, in order to be at all perceptible, had to be quite painful. This peculiar ready exhaustibility of the tactile nerves, existed also for the sensations of contact, pressure and temperature. Since Remak found this condition likewise in the plantar skin, he suggests that it may be the cause of the frequent complaint in ataxia of an *elastic* sensation underneath the feet. (*Centralblatt*, No. 3, 1878.)

Epileptic Attack from Action of Vagus, by Dr. O. Langendorff and stud. R. Zander. (*Centralblatt*, No. 4, 1878.)

While it is difficult to obtain complete arrest of the heart in the normal rabbit by irritation of the peripheral end of the divided vagus, this result